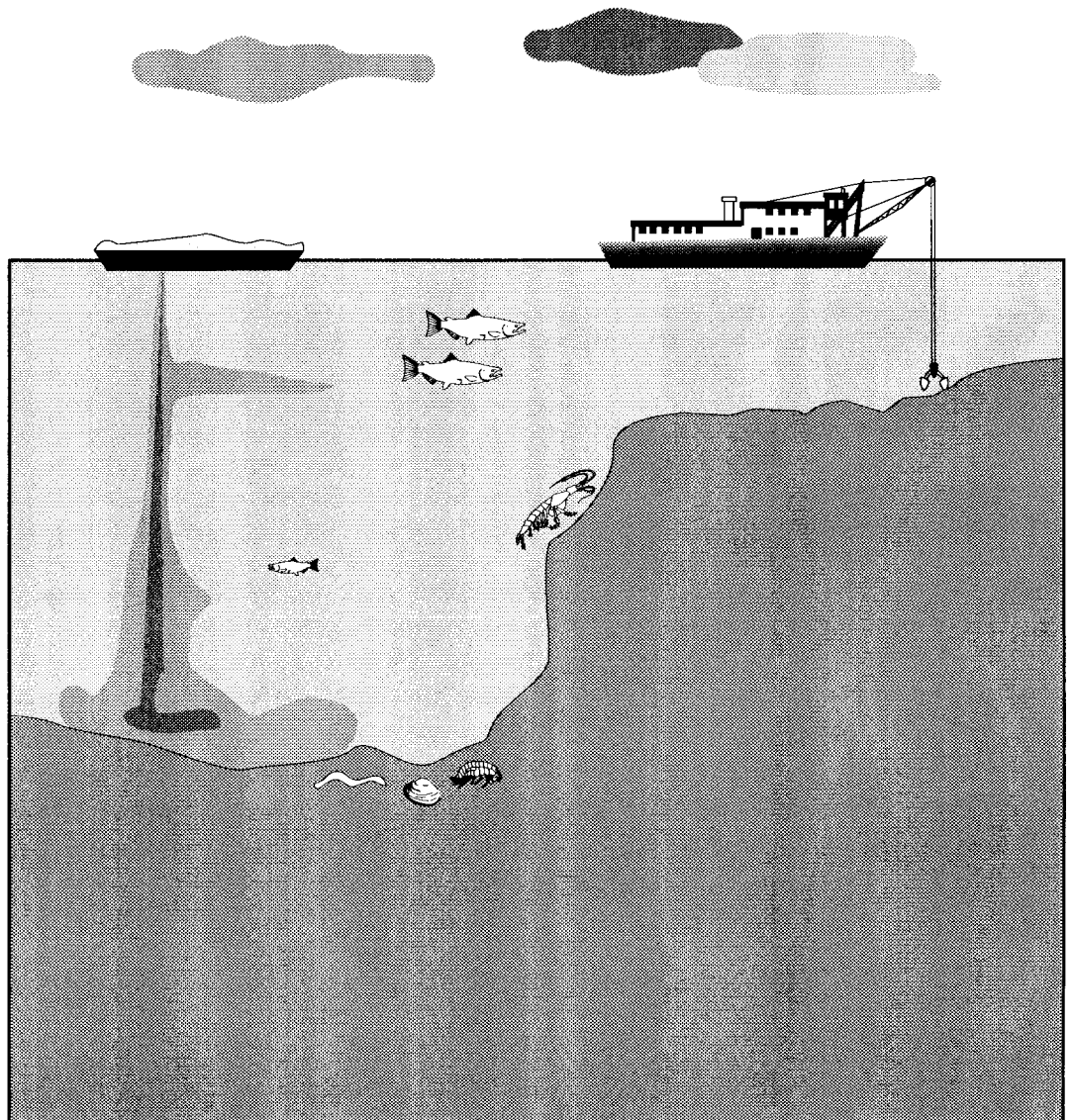




U.S. Army Corps  
of Engineers

# Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. - Testing Manual

## Inland Testing Manual



**EVALUATION OF DREDGED MATERIAL  
PROPOSED FOR DISCHARGE IN WATERS OF THE U.S. - TESTING MANUAL  
(INLAND TESTING MANUAL)**

**Prepared by**

**ENVIRONMENTAL PROTECTION AGENCY  
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Washington, D.C.**

**and**

**DEPARTMENT OF THE ARMY  
United States Army Corps of Engineers  
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Washington, D.C.**

**February 1998**

The testing protocols set out in the Inland Testing Manual are intended solely as guidance for use in conducting testing of dredged material to assess the potential for contaminant-related impacts associated with dredged material disposal into open water. The Manual does not alter the statutory and regulatory framework for permitting decisions under section 404 of the CWA. Under that framework, testing is conducted in order to assist the permitting authority in making factual determinations regarding the effect of the discharge on the aquatic ecosystem, and in determining whether the discharge will comply with the 404(b)(1) Guidelines. See 40 C.F.R. 230.10 and 230.11. The current regulations provide for testing under certain circumstances, and this Manual provides suggested protocols to follow once it has been decided that testing is appropriate. The Guidelines provide flexibility to the permitting authority to decide, based upon the facts of a particular case, whether testing is warranted.

The Manual is intended solely as guidance. The Manual is not intended, nor can it be relied upon, to create any rights or obligations enforceable by any party. The Manual provides the best available technical guidance regarding how dredged material should be tested. While it is generally anticipated that the Agencies will follow the procedures in this Manual, Agency decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from the guidance in the Manual where determined to be appropriate. The document does not, and is not intended to, impose any legally-binding requirements on Federal agencies, States, or the regulated community.

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## PREFACE

The "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual", commonly referred to as the Inland Testing Manual represents a major effort by the U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) to establish procedures applicable to the evaluation of potential contaminant-related environmental impacts associated with the discharge of dredged material in inland waters, near coastal waters, and surrounding environs (that is, all waters other than the ocean and the territorial seas, regulated pursuant to Section 404, CWA). This manual is consistent, to the maximum extent practicable, with the procedures established for ocean waters (i.e., the "Green Book" entitled "Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual" - EPA/USACE, 1991). The USACE and EPA have statutory and regulatory responsibilities with regard to the management of dredged material discharge activities in inland and near coastal waters. The USACE is responsible for regulating non-Federal dredging and dredged material discharge activities through a permit program, and for conducting Federal dredging and dredged material discharge activities in conjunction with its Civil Works Program. EPA is responsible for establishing, in conjunction with the USACE, guidelines pertaining to the evaluation of these activities, and performing oversight actions. Specifically, Section 404 of the Federal Water Pollution Control Act of 1972 (FWPCA), Public Law 92-500, as amended by the Clean Water Act of 1977 (CWA), Public Law 95-217, requires, among other things, that the discharge of dredged or fill material into waters of the U.S. be permitted by the USACE. The USACE also conducts Civil Works dredging and dredged material discharge activities in accordance with Section 404. Section 404 further requires that discharge sites be specified though the application of the Section 404(b)(1) Guidelines (Guidelines) developed by EPA in conjunction with the USACE. Section 404 requires that the "guidelines shall be based upon criteria comparable to the criteria applicable to the territorial seas, contiguous zone, and the ocean". Thus, a clear connection for comparable testing for ocean, inland and near coastal waters was established as early as 1972.

The Guidelines, which impart other requirements in addition to those associated with contaminant-related impacts, are published at 40 CFR 230. This manual provides testing procedures applicable to determining the potential for contaminant-related environmental impacts associated with the discharge of dredged material. Dredged material evaluated under the procedures described in this manual must also satisfy all other applicable requirements of 40 CFR 230-232, 33 CFR 320-330, and 33 CFR 335-338 in order to comply with the Guidelines and to be authorized for discharge.

This manual, which is designed to allow for regional flexibility in implementation and application including development of regional manuals and documentation, will be periodically revised and updated as warranted by advances in regulatory practice and technical understanding. This manual replaces the May 1976 proposed testing protocol, "Ecological Evaluation of Proposed Discharge of Dredged or Fill Material Into Navigable Waters", which will no longer be applicable. The 1976 protocol was developed in response to a requirement in the Federal Register notice of the Guidelines, Vol. 40, No. 173, Friday, 5 September 1975. That notice states the "EPA in conjunction with the Corps of Engineers will publish a procedures manual that will cover summary and description of tests, definitions, sample collection and preservation, procedures, calculations and references." In December 1980, the Guidelines were revised and finalized in the Federal Register Vol. 45, No. 249. The present joint effort by EPA and USACE contains up-to-date testing procedures to implement the Guidelines at Sections 230.60 and 230.61, and is

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intended to bring compatibility and a comparable level of environmental protection for dredged material testing in ocean, inland and near coastal waters.

This manual is one of a series of guidance documents jointly developed by EPA and the USACE pertaining to dredged material disposal. This series includes a document entitled "Evaluating Environmental Effects of Dredged Material Management Alternatives - A Technical Framework" (Framework Document - USACE/EPA, 1992). The Framework Document articulates those factors to be considered in identifying the environmental effects of dredged material management alternatives on a continuum of discharge sites from uplands to the oceans (management alternatives include open water, confined and beneficial use situations) that meet the substantive and procedural requirements of the National Environmental Policy Act (NEPA), the CWA and the Marine Protection, Research, and Sanctuaries Act (MPRSA). The Green Book (EPA/USACE, 1991) is included in the series. Application of the testing guidance in this manual in addition to guidance provided in the Framework Document and the Green Book will allow for consistency in decision making with respect to technical considerations, across statutory boundaries and the continuum of dredged material discharge options.

The contributions made by many individuals from both agencies are gratefully acknowledged. The first and second drafts of the manual were completed by the Environmental Laboratory (EL) of the USACE Waterways Experiment Station (WES): Thomas Wright, primary author; Michael Palermo, author of Appendix B; Paul Schroeder, Michael Palermo, Robert Randall and Billy Johnson, authors of Appendix C. Succeeding drafts were completed by an EPA/USACE Workgroup established by EPA's Office of Science and Technology (OST) within the Office of Water (OW). Mike Kravitz of OST was the Work Assignment Manager. Appendix D was written by Dennis Brandon and Joan Clarke (WES) and Michael Paine (EVS Consultants). Appendix F was written by Gary Ankley (EPA). Appendix G was written by Sandra Salazar and Peter Chapman (EVS Consultants). Henry Lee and Bruce Boese (EPA) contributed valuable information pertaining to sediment bioaccumulation testing. Carie Schaffer and Robert Johnson (Tetra Tech, Inc.) provided computer support for internet and electronic versions of the document, respectively.

The Workgroup was comprised of individuals from headquarters, field offices and research laboratories of both agencies with scientific and/or programmatic experience related to dredged material discharge activities.

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Review of this manual was conducted by EPA through OW [OST and the Office of Wetlands, Oceans and Watersheds (OWOW)] and by USACE through the Office of the Chief of Engineers (Regulatory Branch, Dredging and Navigation Branch, Office of Environmental Policy) and EL of WES. In addition, the results of the EPA's Science Advisory Board (SAB, 1992) review of the 1991 Green Book were considered in detail, where applicable, during development of this manual. The results of EPA's SAB (1994) review of the draft Inland Testing Manual were considered during its finalization. Regional issues which have National relevance were provided by EPA Region and USACE Division and District staff, and were incorporated into the appropriate sections of this document. This manual provides comprehensive testing guidance from a national perspective. Within the framework of this document, EPA Regions and USACE Districts and Divisions will develop region-specific guidance and/or procedures, as necessary (e.g., region-specific test species), to provide sufficient information to make informed dredged material discharge decisions.

This manual should be cited as follows:

EPA/USACE. 1998. Evaluation of dredged material proposed for discharge in waters of the U.S. - Testing manual. EPA-823-B-98-004, Washington, D.C.

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## DEFINITIONS

The following definitions of words and terms are specific to the use of this manual and, where applicable, are quoted verbatim from the Guidelines (cf. Definitions at 40 CFR 230.3 and/or other parts; such definitions are starred\*). Thorough familiarization with the following definitions is required prior to use of this manual.

**Accuracy:** The ability to obtain a true value; determined by the degree of agreement between an observed value and an accepted reference value.

**Acid volatile sulfide (AVS):** The sulfides removed from sediment by cold acid extraction, consisting mainly of H<sub>2</sub>S and FeS. AVS is a possible predictive tool for divalent metal sediment toxicity.

**Acute:** Having a sudden onset, lasting a short time.

**Acute toxicity:** Short-term toxicity to organism(s) that have been affected by the properties of a substance, such as contaminated sediment. The acute toxicity of a sediment is generally determined by quantifying the mortality of appropriately sensitive organisms that are put into contact with the sediment, under either field or laboratory conditions, for a specified period.

**\*Adjacent:** Bordering, contiguous or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands".

**Application factor (AF):** A numerical, unitless value, calculated as the threshold chronically toxic concentration of a test substance divided by its acutely toxic concentration. The AF is usually reported as a range and is multiplied by the median lethal concentration as determined in a short-term (acute) toxicity test to estimate an expected no-effect concentration under chronic exposure.

**Benchmark organism:** Test organism designated by USACE and EPA as appropriately sensitive and useful for determining biological data applicable to the real world. Test protocols with such organisms are published, reproducible and standardized.

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**Bioaccumulation:** The accumulation of contaminants in the tissue of organisms through any route, including respiration, ingestion, or direct contact with contaminated water, sediment, pore water or dredged material. [The regulations require that bioaccumulation be considered as part of the environmental evaluation of dredged material proposed for disposal. This consideration involves predicting whether there will be a cause-and-effect relationship between an organism's presence in the area influenced by the dredged material and an environmentally important elevation of its tissue content or body burden of contaminants above that in similar animals not influenced by the disposal of the dredged material].

**Bioaccumulation factor:** The degree to which an organism accumulates a chemical compared to the source. It is a dimensionless number or factor derived by dividing the concentration in the organism by that in the source.

**Bioassay:** A bioassay is a test using a biological system. It involves exposing an organism to a test material and determining a response. There are two major types of bioassays differentiated by response: **toxicity tests** which measure an effect (e.g., acute toxicity, sublethal/chronic toxicity) and **bioaccumulation tests** which measure a phenomenon (e.g., the uptake of contaminants into tissues).

**Bioavailable:** Can affect organisms.

**Bioconcentration:** Uptake of a substance from water.

**Biomagnification:** Bioaccumulation up the food chain, e.g., the route of accumulation is solely through food. Organisms at higher trophic levels will have higher body burdens than those at lower trophic levels.

**Biota sediment accumulation factor:** Relative concentration of a substance in the tissues of an organism compared to the concentration of the same substance in the sediment.

**Bulk sediment chemistry:** Results of chemical analyses of whole sediments (in terms of wet or dry weight), without normalization (e.g., to organic carbon, grain-size, acid volatile sulfide).

**Can:** Is used to mean "is able to".

**Chronic:** Involving a stimulus that is lingering or which continues for a long time.

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**Chronic toxicity:** See **sublethal/chronic toxicity**.

**Comparability:** The confidence with which one data set can be compared to others and the expression of results consistent with other organizations reporting similar data. Comparability of procedures also implies using methodologies that produce results comparable in terms of precision and bias.

**Completeness:** A measure of the amount of valid data *obtained* versus the amount of data originally *intended* to be collected.

**Confined disposal:** A disposal method that isolates the dredged material from the environment. Confined disposal is placement of dredged material within diked confined disposal facilities via pipeline or other means.

**Confined disposal facility (CDF):** A diked area, either in-water or upland, used to contain dredged material. The terms confined disposal facility (CDF), dredged material containment area, diked disposal facility, and confined disposal area are used interchangeably.

**Constituents:** Chemical substances, solids, liquids, organic matter, and organisms associated with or contained in or on dredged material.

**\*Contaminant:** A chemical or biological substance in a form that can be incorporated into, onto or be ingested by and that harms aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment, and includes but is not limited to the substances on the 307(a)(1) list of toxic pollutants promulgated on January 31, 1978 (43 FR 4109). [Note: A contaminant that causes actual harm is technically referred to as a pollutant, but the regulatory definition of a "pollutant" in the Guidelines is different, reflecting the intent of the CWA.]

**Contaminant of concern:** A contaminant present in a given sediment thought to have the potential for unacceptable adverse environmental impact due to a proposed discharge.

**Control sediment:** A sediment essentially free of contaminants and which is used routinely to assess the acceptability of a test. Control sediment may be the sediment from which the test organisms are collected or a laboratory sediment, provided the organisms meet control standards. Test procedures are conducted with the control sediment in the same way as the reference sediment and dredged material. The purpose of the control sediment is to confirm the biological acceptability of the test conditions and to help verify the health of the organisms during the test. Excessive mortality in

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the control sediment indicates a problem with the test conditions or organisms, and can invalidate the results of the corresponding dredged material test.

**Data quality indicators:** Quantitative statistics and qualitative descriptors which are used to interpret the degree of acceptability or utility of data to the user; include bias (systematic error), precision, accuracy, comparability, completeness, representativeness, detectability and statistical confidence.

**Data quality objectives (DQOs):** Qualitative and quantitative statements of the overall uncertainty that a decision maker is willing to accept in results or decisions derived from environmental data. DQOs provide the framework for planning environmental data operations consistent with the data user's needs.

**Discharge of dredged material:** Any addition of dredged material into waters of the United States. [Dredged material discharges include: open water discharges; discharges resulting from unconfined disposal operations (such as beach nourishment or other beneficial uses); discharges from confined disposal facilities which enter waters of the United States (such as effluent, surface runoff, or leachate); and, overflow from dredge hoppers, scows, or other transport vessels]. Material resuspended during normal dredging operations is considered "de minimus" and is not regulated under Section 404 as a dredged material discharge. See 33 CFR 323.2 for a detailed definition. The potential impact of resuspension due to dredging can be addressed under NEPA.

**\*Disposal site:** That portion of the "waters of the United States" where specific disposal activities are permitted and consist of a bottom surface area and any overlying volume of water. In the case of wetlands on which surface water is not present, the disposal site consists of the wetland surface area. [Note: upland locations, although not mentioned in this definition in the Regulations, can also be disposal sites].

**District:** A USACE administrative area.

**\*Dredged material:** Material that is excavated or dredged from waters of the United States. [A general discussion of the nature of dredged material is provided by Engler et al. (1991a)].

**EC<sub>50</sub>:** The median effective concentration. The concentration of a substance that causes a specified effect (generally sublethal rather than acutely lethal) in 50% of the organisms tested in a laboratory toxicity test of specified duration.

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**Elutriate:** Material prepared from the sediment dilution water and used for chemical analyses and toxicity testing. Different types of elutriates are prepared for two different procedures as noted in this manual.

**Evaluation:** The process of judging data in order to reach a decision.

**\*Factual determination:** A determination in writing of the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical and biological components of the aquatic environment in light of Subparts C-F of the Guidelines.

**Federal Standard:** The dredged material disposal alternative(s) identified by the U.S. Army Corps of Engineers that represent the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process. [See Engler et al. (1988) and 33 CFR 335-338].

**\*Fill material:** Any material used for the primary purpose of replacing an aquatic area with dry land or changing the bottom elevation of a water body for any purpose. The term does not include any pollutant discharged into the water primarily to dispose of waste, as that activity is regulated under Section 402 of the Clean Water Act. [Note: dredged material can be used as fill material].

**Grain-size effects:** Mortality or other effects in laboratory toxicity tests due to sediment granulometry, not chemical toxicity. [It is clearly best to use test organisms which are not likely to react to grain-size but, if this is not reasonably possible, then testing must account for any grain-size effects.]

**Guidelines:** Substantive environmental criteria by which proposed discharges of dredged material are evaluated. CWA Section 404(b)(1) final rule (40 CFR 230) promulgated December 24, 1980.

**LC<sub>50</sub>:** The median lethal concentration. The concentration of a substance that kills 50% of the organisms tested in a laboratory toxicity test of specified duration.

**Leachate:** Water or any other liquid that may contain dissolved (leached) soluble materials, such as organic salts and mineral salts, derived from a solid material.

**Lethal:** Causing death.

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**Loading density:** The ratio of organism biomass or numbers to the volume of test solution in an exposure chamber.

**Management actions:** Those actions considered necessary to rapidly render harmless the material proposed for discharge (e.g., non-toxic, non-bioaccumulative) and which may include containment in or out of the waters of the U.S. (see 40 CFR Subpart H). Management actions are employed to reduce adverse impacts of proposed discharges of dredged material.

**Management unit:** A manageable, dredgeable unit of sediment which can be differentiated by sampling and which can be separately dredged and disposed within a larger dredging area. Management units are not differentiated solely on physical or other measures or tests but are also based on site- and project-specific considerations.

**May:** Is used to mean "is allowed to".

**Method detection limit (MDL):** The minimum concentration of a substance which can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

**Might:** Is used to mean "could possibly."

**\*Mixing zone:** A limited volume of water serving as a zone of initial dilution in the immediate vicinity of a discharge point where receiving water quality may not meet quality standards or other requirements otherwise applicable to the receiving water. [The mixing zone may be defined by the volume and/or the surface area of the disposal site or specific mixing zone definitions in State water quality standards].

**Must:** In this manual refers to requirements that have to be addressed in the context of compliance with the Guidelines.

**Open water disposal:** Placement of dredged material in rivers, lakes or estuaries via pipeline or surface release from hopper dredges or barges.

**Pathway:** In the case of bioavailable contaminants, the route of exposure (e.g., water, food).

**\*Pollution:** The man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of an aquatic ecosystem. [See definition of **contaminant**].

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**\*Practicable:** Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

**Practical quantitation limit (PQL):** The lowest concentration that can be reliably quantified with specified limits of precision and accuracy during routine laboratory operating conditions.

**Precision:** The ability to replicate a value; the degree to which observations or measurements of the same property, usually obtained under similar conditions, conform to themselves. Usually expressed as standard deviation, variance or range.

**QA:** Quality assurance, the total integrated program for assuring the reliability of data. A system for integrating the quality planning, quality control, quality assessment, and quality improvement efforts to meet user requirements and defined standards of quality with a stated level of confidence.

**QC:** Quality control, the overall system of technical activities for obtaining prescribed standards of performance in the monitoring and measurement process to meet user requirements.

**Reason to believe:** Subpart G of the 404(b) (1) guidelines requires the use of available information to make a preliminary determination concerning the need for testing of the material proposed for dredging. This principle is commonly known as "reason to believe", and is contained in Tier I of the tiered testing framework. The decision to not perform additional testing based on prior information must be documented, in order to provide a "reasonable assurance that the proposed discharge material is not a carrier of contaminants" (230.60(b)).

**Reference sediment:** Point of comparison for evaluating test sediment. Testing requirements in the Section 404(b)(1) Guidelines regarding the point of comparison for evaluating proposed discharges of dredged material are being updated to provide for comparison to a "reference sediment" as opposed to sediment from the disposal site. Because subsequent discharges at a disposal site could adversely impact the point of comparison, adoption of a reference sediment that is unimpacted by previous discharges of dredged material will result in a more scientifically sound evaluation of potential individual and cumulative contaminant-related impacts. This change to the Guidelines was proposed in the Federal Register in January 1995, public comments have been received, and a final rule Notice is being prepared. It is expected that the final rule will be published prior to July 1, 1998, and as a result the reference sediment approach will be implemented in the ITM.

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**Reference site:** The location from which **reference sediment** is obtained.

**Region:** An EPA administrative area.

**region:** A geographical area.

**Regulations:** Procedures and concepts published in the Code of Federal Regulations for evaluating the discharge of dredged material into waters of the United States.

**Representativeness:** The degree to which sample data depict an existing environmental condition; a measure of the total variability associated with sampling and measuring that includes the two major error components: systematic error (bias) and random error. Sampling representativeness is accomplished through proper selection of sampling locations and sampling techniques, collection of sufficient number of samples, and use of appropriate subsampling and handling techniques.

**Sediment:** Material, such as sand, silt, or clay, suspended in or settled on the bottom of a water body.

**Should:** Is used to state that the specified condition is recommended and ought to be met unless there are clear and definite reasons not to do so.

**Standard operating procedure (SOP):** A written document which details an operation, analysis, or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.

**Standardized:** In the case of methodology, a published procedure which has been peer reviewed (e.g., journal, technical report), and generally accepted by the relevant technical community of experts.

**Sublethal:** Not directly causing death; producing less obvious effects on behavior, biochemical and/or physiological function, histology of organisms.

**Sublethal/chronic toxicity:** Biological tests which use such factors as abnormal development, growth and reproduction, rather than solely lethality, as end-points. These tests involve all or at least an important, sensitive portion of an organism's life-history. A sublethal endpoint may result either from short-term or long-term (chronic) exposures.

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**Target detection limit:** A performance goal set by consensus between the lowest, technically feasible, detection limit for routine analytical methods and available regulatory criteria or guidelines for evaluating dredged material. The target detection limit is, therefore, equal to or greater than the lowest amount of a chemical that can be reliably detected based on the variability of the blank response of routine analytical methods. However, the reliability of a chemical measurement generally increases as the concentration increases. Analytical costs may also be lower at higher detection limits. For these reasons, a target detection limit is typically set at not less than 10 times lower than available dredged material guidelines.

**Tests/testing:** Specific procedures which generate biological, chemical, and/or physical data to be used in evaluations. The data are usually quantitative but may be qualitative (e.g., taste, odor, organism behavior). Testing for discharges of dredged material in waters of the United States is specified at 40 CFR 230.60 and 230.61 and is implemented through the procedures in this manual.

**Tiered approach:** A structured, hierarchical procedure for determining data needs relative to decision-making, which involves a series of tiers or levels of intensity of investigation. Typically, tiered testing involves decreased uncertainty and increased available information with increasing tiers. This approach is intended to ensure the maintenance and protection of environmental quality, as well as the optimal use of resources. Specifically, least effort is required in situations where clear determinations can be made of whether (or not) unacceptable adverse impacts are likely to occur based on available information. Most effort is required where clear determinations cannot be made with available information.

**Toxicity:** see **Acute toxicity**; **Sublethal/chronic toxicity**, **Toxicity test**.

**Toxicity test:** A bioassay which measures an effect (e.g., acute toxicity, sublethal/chronic toxicity). Not a **bioaccumulation test** (see definition of **bioassay**).

**Water quality certification:** A state certification, pursuant to Section 401 of the Clean Water Act, that the proposed discharge of dredged material will comply with the applicable provisions of Sections 301, 303, 306 and 307 of the Clean Water Act and relevant State laws. Typically this certification is provided by the affected State. In instances where the State lacks jurisdiction (e.g., Tribal Lands), such certification is provided by EPA or the Tribe (with an approved certification program).

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**Water quality standard:** A law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an anti-degradation statement.

**Waters of the U.S.:** In general, all waters landward of the baseline of the territorial sea and the territorial sea. Specifically, all waters defined in Section 230.3 (s) of the Guidelines. [See Appendix A].

**Whole sediment:** The sediment and interstitial waters of the proposed dredged material or reference sediment that have had minimal manipulation. For purposes of this manual, press-sieving to remove organisms from test sediments, homogenization of test sediments, compositing of sediment samples, and additions of small amounts of water to facilitate homogenizing or compositing sediments may be necessary to conducting bioassay tests. These procedures are considered unlikely to substantially alter chemical or toxicological properties of the respective whole sediments except in the case of AVS (acid volatile sulfide) measurements (EPA, 1991a) which are not presently required. Alternatively, wet sieving, elutriation, or freezing and thawing of sediments may alter chemical and/or toxicological properties, and sediment so processed should not be considered as whole sediment for bioassay purposes.

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<b>LIST OF ACRONYMS</b>
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AAS - Atomic Absorption Spectrometry  
AF - Application Factor  
AVS - Acid Volatile Sulfide  
BAF - Bioaccumulation Factor  
BCF - Bioconcentration Factor  
BSAF - Biota Sediment Accumulation Factor  
CDF - Confined Disposal Facility  
CFR - Code of Federal Regulations  
CLP - Contract Laboratory Program  
CWA - Clean Water Act  
ECD - Electron Capture Detection  
EO - Executive Orders  
EPA - Environmental Protection Agency  
FDA - Food and Drug Administration  
FR - Federal Register  
GC - Gas Chromatography  
GFAAS - Graphite Furnace Atomic Absorption Spectrometry  
IAEA - International Atomic Energy Agency  
ICP - Inductively Coupled Plasma  
ITM - Inland Testing Manual  
LBP - Lipid Bioaccumulation Potential  
MPRSA - Marine Protection, Research and Sanctuaries Act  
MS - Mass Spectrometry  
NBS - National Bureau of Standards  
NEPA - National Environmental Policy Act  
NIST - National Institute for Standards and Technology  
NOAA - National Oceanic Atmospheric Administration  
NPDES - National Pollutant Discharge Elimination System  
NRC - National Research Council of Canada  
PAH - Polynuclear Aromatic Hydrocarbons  
PCB - Polychlorinated Biphenyl  
QA - Quality Assurance

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QC - Quality Control  
QSAR - Quantitative Structure Activity Relationship  
RHA - Rivers and Harbors Act of 1899  
SAB - Science Advisory Board  
SIM - Selected Ion Monitoring  
SOP - Standard Operating Procedure  
SQC - Sediment Quality Criteria  
SQS - Sediment Quality Standards  
SRM - Standard Reference Material  
TBP - Theoretical Bioaccumulation Potential  
TDL - Target Detection Limit  
TEF - Toxicity Equivalency Factor  
TOC - Total Organic Carbon  
TIE - Toxicity Identification Evaluation  
USACE - U.S. Army Corps of Engineers  
USCS - Unified Soil Classification System  
WQC - Water Quality Criteria  
WQS - Water Quality Standards

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# CONVERSIONS

## METRIC TO IMPERIAL

### WEIGHT:

$$1\text{Kg} = 1000\text{g} = 2.205\text{lb}$$

$$1\text{g} = 1000\text{mg} = 2.205 \times 10^{-3}\text{lb}$$

$$1\text{ mg} = 1000\mu\text{g} = 2.205 \times 10^{-6}\text{lb}$$

### LENGTH:

$$1\text{m} = 100\text{cm} = 3.28\text{ ft.} = 39.370\text{in}$$

$$1\text{cm} = 10\text{mm} = 0.3937\text{in}$$

$$1\text{mm} = 1000\mu\text{g} = 0.03937\text{in}$$

### CONCENTRATION:

$$1\text{ppm} = 1\text{mg/L} = 1\text{mg/Kg} = 1\mu\text{g/g} = 1\text{mL/m}^3$$

$$1\text{g/cc} = 1\text{Kg/L} = 8.3454\text{ lb/gallon (US)}$$

$$1\text{g/m}^3 = 1\text{mg/L} = 6.243 \times 10^{-5}\text{lb/ft}^3$$

### VOLUME:

$$1\text{L} = 1000\text{mL}$$

$$1\text{mL} = 1000\mu\text{L}$$

$$1\text{cc} = 10^{-6}\text{m}^3$$

### FLOW:

$$1\text{m/s} = 196.850\text{ ft/min} = 3.281\text{ ft/s}$$

$$1\text{ m}^3/\text{s} = 35.7\text{ ft}^3/\text{s}$$

### AREA:

$$1\text{ m}^2 = 10.764\text{ft}^2$$

$$1\text{ hectare (ha)} = 10000\text{m}^2 = 2.471\text{ acres}$$

## IMPERIAL TO METRIC

$$1\text{lb} = 16\text{ oz} = 0.4536\text{Kg}$$

$$1\text{ foot (ft)} = 12\text{in} = 0.3048\text{m}$$

$$1\text{ lb/gal} = 7.481\text{lb/ft}^3 = 0.120\text{g/cc} =$$

$$119.826\text{g/L} = 119.826\text{Kg/m}^3$$

$$1\text{ oz/gal} = 7.489\text{Kg/m}^3$$

$$1\text{yd}^3 = 27\text{ft}^3 = 764.555\text{ L} = 0.7646\text{m}^3$$

$$1\text{ acre-ft} = 1233.482\text{m}^3$$

$$1\text{ gallon (US)} = 3785\text{cc}$$

$$1\text{ ft}^3 = 0.0283\text{m}^3 = 28.3168\text{ L}$$

$$1\text{ ft}^3/\text{s} = 1699.011\text{ L/min} = 28.317\text{ L/s}$$

$$1\text{ ft}^2/\text{hr} = 2.778 \times 10^{-4}\text{ ft}^2/\text{s} = 2.581 \times 10^{-5}\text{m}^2/\text{s}$$

$$1\text{ ft/s} = 0.3048\text{m/s}$$

$$1\text{ yd}^3/\text{min} = 0.45\text{ft}^3/\text{s}$$

$$\text{yd}^3/\text{s} = 3.366\text{ gal/s} = 12.743\text{ L/s}$$

$$1\text{ ft}^2 = 0.0929\text{m}^2$$

$$1\text{ acre} = 4046.856\text{m}^2 = 0.405\text{ ha}$$